III DESCRIPTION OF HABITATS AND SPECIES

The Sacramento River has meandered across its alluvial valley for thousands of years, transforming the landscape and supporting a unique riparian ecosystem within its floodplain. The dynamic riverine processes examined in Chapter II have created and maintained this riparian ecosystem. The plants in the riparian communities have adapted to and become dependent upon these natural processes. In turn, many species of fish and wildlife that inhabit the riparian corridor have adapted exclusively to these habitat communities. As a result, threats to the viability and connectivity of this habitat are threats to the viability of those species.

The wildlife and fish resources of the Sacramento River riparian ecosystem are of great natural and economic importance. The river corridor supports a great variety of resident and migratory species. For example, waterfowl and songbirds are attracted by the diversity of habitat. Many neotropical songbirds breed in the riparian communities along the river and winter in Central and South America while terrestrial species prosper in the moist and lush environment. The river supports four distinct runs of Chinook salmon and is the greatest source of supply for the commercial salmon fishery off the California coast. It also supports runs of other anadromous game fish including steelhead trout, striped bass, shad and sturgeon, which combine to generate substantial local economic activity.

❖ Habitat Communities and Plant Species

The Sacramento River Wildlife Area is part of a rich riparian ecosystem that supports a wide variety of wildlife and fish on a seasonal and year-round basis. Within this ecosystem, the riparian habitat provides the food, water, and shelter necessary for the reproduction and survival of Special Status Species, other native species and game species of fish and wildlife. The habitat includes various forms of vegetation, wetlands, banks, sand and gravel bars along the river. The *Sacramento River Conservation Area Handbook,* Chapter 2 contains a description of the habitats in the river corridor. Much of the material in this section is adapted from the *Handbook* with the input of Department biologists and botanists. A more complete listing of the plant species known or expected to exist in the Wildlife Area is included as Appendix D.

Ecological Adaptation – The riparian vegetation along the Sacramento River has evolved in an environment maintained by the natural disturbance regime. This regime is primarily composed of flooding and substrate erosion and deposition. The majority of the species are phreatophytyes, which must have their roots in contact with a stable water supply during long periods of the year. Most of the trees within the riparian corridor are broadleaved and deciduous during the winter months. Such broad leaves enable these trees to maximize sun exposure, thus maximizing growth. Such early colonizing species as willows and cottonwood exhibit rapid growth of foliage and roots necessary for pioneer colonizers to survive during the hot, dry summers on a substrate composed of alluvial sands or gravels with available

subsurface water. Other adaptations that plants have made to thrive in the riparian corridor include:

- seed dispersal mechanisms to ensure successful recruitment such as seeds which float and are resistant to rotting;
- adventitious roots (roots that bud from buried stems) which form after sediments are deposited over plants during flood events;
- ability to tolerate low levels of oxygen in soil in flooding events, and;
- ability to form suckers and roots after mechanical damage.

These adaptations help to ensure plant survival in the portions of the Wildlife Area that are subject to frequent riverine disturbances. These mechanisms dictate that the initial colonizers may not be able to replace themselves at a site. Instead, they will colonize other newly disturbed or deposited areas and the cycle will be repeated.

As silt accumulates under the initial willow-cottonwood scrub, other trees such as box elder and ash are able to germinate in the spring after flooding has ended. Because the existing trees have slowed the flood flows, the materials deposited in these areas tend to have a higher percentage of fine material such as silt. This finer material builds soils that are able to retain moisture longer than sand and gravel substrates and thus additional species can thrive. Species such as box elder and ash can tolerate some deposition, but not to the same extent as the early- colonizing cottonwood and willow species. On higher areas of the floodplain where the disturbance regime is more muted and deposited soils are deeper, species such as valley oak and sycamore are typically dominant.

Flood events can also result in channel avulsions, which can bring about major physical change in a short period of time. The Wilson Landing and Merrill's Landing Units were the sites of such sudden changes in the river channel that resulted in a profound impact on the habitat characteristics of the immediate area. The new channels that were formed through avulsions in the 1970's quickly became the active channels, resulting in the creation of oxbow lakes within the former channel. These oxbow areas benefited from the adaptations of the native plant species and the river's steady deposition of sediment. Working in tandem these forces can develop "optimal" riparian habitat for Special Status Species such as the yellow-billed cuckoo within as few as 12 years (Greco, 1999).

As noted in the previous Chapter II, the loss of riverine processes, primarily related to flow regulation and bank protection, has seriously impacted the ability of the river to meander and to create and renew riparian habitat. This loss of natural processes has also seriously affected the ability of plant species to recolonize land in the Wildlife Area, especially land on High Terrace sites. These changes to the natural situation make the conservation and restoration of riparian habitat necessary to support Special Status Species, other native species and game species of fish and wildlife.

Successional Stages – From a distance, the riparian communities of the Sacramento River appear to be a uniform blanket of lush, green growth. A closer view, however, reveals that there are distinct bands of vegetation that are differentiated by plant species composition, forest structure and wildlife usage. These areas of vegetation are, in turn, differentiated by the magnitude that they are affected by the disturbance regimes and by their position on the floodplain. The Wildlife Area is located adjacent to and in close proximity to the river where the natural disturbance regime

results in an environment of continual physical change. The riparian communities and their associated vegetation species have adapted to colonize and establish themselves in successional stages as these areas are physically changed over time.

The successional stages of the riparian communities that occur in the Wildlife Area can be classified into several distinct plant communities for overview purposes. In the field, however, the pattern of riparian communities is far more complex. Any one species of tree, shrub or vine can occur in more than one natural community. There is an intergrading between communities and there is rarely an abrupt edge between them. Figure 5 illustrates the typical succession pattern for these communities in relation to river hydrology and channel movement. The Figure incorporates a fifth riparian community the Valley Oak Woodland, which exists in some upland areas above the Wildlife Area. It should be noted that the clearing of riparian forest for other uses, the presence of large project levees and the loss of natural riverine process often interrupts the typical, natural successional pattern reflected on the diagram. The riverine process also creates other aquatic and marsh habitats that are not reflected in this simplified description of typical succession stages.

The California Natural Diversity Database (NDDB/Holland) classification system was chosen for the primary description of habitat in this Plan for consistency with the *Handbook*. This system is most known by the public in reference to the Wildlife Area. The descriptions of the habitat communities relate to the typical situation and do not reflect variations related to the loss of some natural riverine process in the Wildlife Area. It is important to note that this loss can result in interference with the typical successional patterns.

Great Valley Riparian Forest – The Great Valley Riparian Forest communities, classified by NDDB/Holland, are the dominant communities in the Wildlife Area and the focus of this Plan. The Great Valley Riparian Forest series of habitat communities are uniquely adapted to the natural processes of the river and the resulting natural environment. Also prominently represented in the Wildlife Area are the Coastal and Valley Freshwater Marsh and the Great Valley Willow Scrub communities. While these communities do not specifically fall within the Great Valley Riparian Forest series in NDDB/Holland, they are seral stage communities that often succeed to the Great Valley Cottonwood Forest. For the purposes of this Plan, these communities are treated as components of the Great Valley Riparian Forest series.

The Great Valley Riparian Forest communities are a biologically rich habitat. The cottonwood-willow areas support more breeding avian species that any other comparable, broad California habitat type (Gaines, 1977). Riparian forests along the Sacramento River have several characteristics which enable them to support such an abundance and diversity of wildlife. Abundant resources, high structure and habitat diversity (maintained over time by flooding and channel movement) and linear continuity all contribute to the diversity of species in the Wildlife Area.

Proximity to water, a variety of soils and periodic influx of nutrient-rich sediment from flooding all contribute to the abundance of resources in the riparian forest system. This abundance continues through the summer months, in contrast with much of California, which is hot and dry such that many plant species outside of the riparian corridor go dormant. The riparian forests attract a vast array of terrestrial and aquatic insects, which in turn attract many species of birds, fish and mammals.

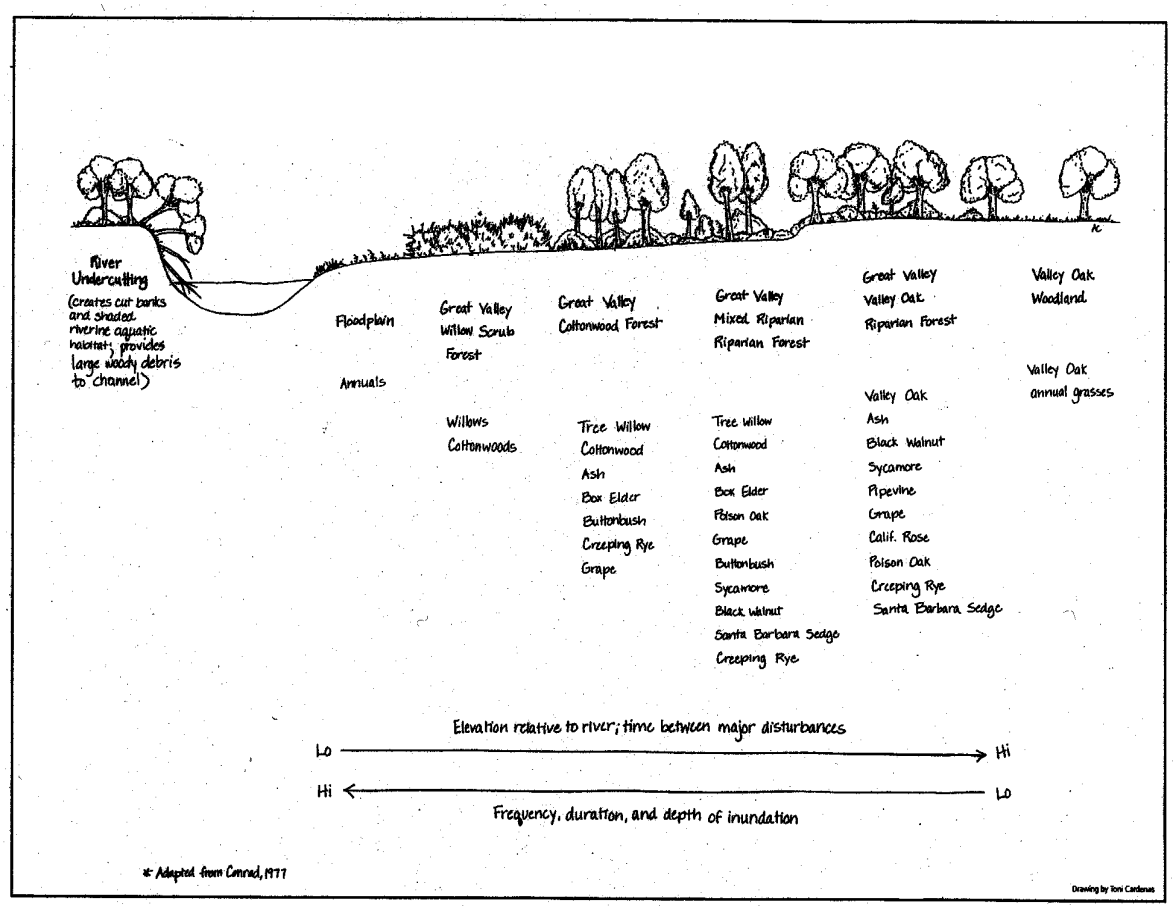

Figure 5. Typical Plant Communities and Successional Stages

* Illustration from the *Sacramento River Conservation Area Handbook.*

Coastal and Valley Freshwater Marsh occurs commonly in the Wildlife Area on the lowland periphery of the side channels, sloughs and oxbow lakes that are formed by the natural riverine processes. These areas are seasonally inundated to a substantial depth by floodwaters. The plant community is typically dominated by monocots up to two meters in height. These include, cattails, bulrush, sedges, spike rushes and watercress. Rooted aquatic species with floating stems and leaves may also be present including water primrose, water smartweed and pondweed. Black willow and button brush are also common at the edges of the water. The Coastal and Valley Freshwater Marsh areas may succeed to the Great Valley Willow Scrub community if deposition raises the level of the land above the permanent water level and these areas can rapidly move to the Great Valley Cottonwood Riparian Forrest community when deposition rates are substantial. This community is especially important for many species of migratory birds and fish.

- **Great Valley Willow Scrub** is the most common pioneering community found on depositional areas (typically point bars) on the river's edge. The community will tend to survive along a band that meets the substrate, texture and moisture requirements of germinating seeds. The young plants are adapted to a coarse substrate such as sand or gravel. The rapidly growing root systems must stay in contact with water as it recedes to summer levels. If the right conditions exist,

the narrow band of cottonwoods in this community will become the riparian forests of the future. Common species in this community are the sandbar willow, other willow species (black, red, yellow and arroyo willows) and Fremont cottonwood. Openings within the willow scrub may be covered by annual and perennial grasses and forbs. As vegetation slows the velocity of flood flows, deposition increases reducing the frequency and duration of inundation. As this occurs, California sycamore, box elder and Oregon ash may become established. This community intergrades with and generally succeeds to the Great Valley Cottonwood Riparian Forrest.

The initial colonization and long-term survival of these species is directly related to the river's flow regime. If the flow level drops too fast, the roots of young plants cannot reach groundwater levels and mortality occurs. Research indicates that manipulation of the flow regime on the river can interfere with the colonization of cottonwoods on recently deposited areas (Roberts et al., 2002).

- **Great Valley Cottonwood Riparian Forest** is typically the successor community to the Great Valley Willow Scrub. As t he river meanders away from this area the land is raised through deposition of sediment and the frequency of flooding is diminished. This community is dominated by Fremont cottonwood, which sometimes constitutes the entire upper canopy. A second tall tree, the black willow, is often a significant member of the community. This community has a total canopy coverage of greater than 80%. Many species are able to germinate under the dense canopy cover, including berries, California rose, wild grape and poison oak, and many smaller tree species combine to develop into a dense understory. Such areas are commonly referred to as "riparian jungle." Trees such as box elder and ash may become established in the understory, but do not typically become significant canopy species until flooding becomes less frequent.

  The tall form of the cottonwood trees is visible from a great distance. It is a common indicator of the river when crossing the featureless areas of the Sacramento Valley. This community intergrades with and generally succeeds to the Great Valley Mixed Riparian Forest away from the river.

- **Great Valley Mixed Riparian Forest** is typically the successor to the Great Valley Cottonwood Forest as the land area is further raised through deposition of sediment and flooding frequency continues to diminish. This community has a diverse, often dense, mixture of tall cottonwoods and willows in combination with sycamores, box elders, black walnuts and alders at greater than 80% canopy coverage. Shrubs such as buttonbrush, blackberries and poison oak are often covered by an assortment of vines (clematis, wild grape and pipevine) which extend up into the overstory trees. Perennial grasses, such as creeping wild rye, and Santa Barbara sedge may form dense pockets in the understory. Openings in this community may also contain elderberry savanna. This community intergrades with the Great Valley Cottonwood Riparian Forest in lower lying areas and the Great Valley Valley Oak Riparian Forest in higher areas.

  This community may be a substantial distance from the active channel but still experiences relatively frequent flooding. This brings additional deposition but not necessarily the damaging flows and subsequent erosion. As the community becomes drier (i.e. further above the water table), species such as the valley oaks are able to germinate and become established. Over an extensive period of time valley oaks become dominant and the community develops into the most mature of the riparian vegetation types, the Great Valley Valley Oak Riparian Forest.

- **Great Valley Valley Oak Riparian Forest** is dominated by tall, mature valley oaks with significant numbers of sycamores, black walnuts and ash. The canopy is typically less dense than the Great Valley Cottonwood or Mixed Riparian Forest at less than 60% canopy coverage. The understory may be dense with vines and shrub species typical in the Mixed Riparian Forest, shrub species from drier sites and often stands of perennial grasses and sedges. Often present with this community type are very old specimens of elderberry plants, which are the host of the valley elderberry longhorn beetle.

  This community is subject to periodic flooding, but of a lesser frequency and duration that the preceding communities. This brings additional deposition and, as a site rises further above the water table, it can develop into a Valley Oak Woodland. Within the Wildlife Area the Valley Oak Woodland does not currently exist.

- **Other Terrestrial Habitat Communities** occur in pockets in or adjacent to the Wildlife Area and there are also indications of communities that may have previously existed on the Wildlife Area. These communities include the following:

  - Valley Needlegrass Grassland
  - Valley Wildrye Grassland
  - Mule Fat Scrub
  - Buttonbush Scrub
  - Elderberry Savanna

  These habitat communities are often substantially affected by invasive, nonnative species, which can dominate the mix of plants in individual areas. While these grassland and scrub habitats do not represent a large portion of the Wildlife Area, they do provide important habitat to the resident wildlife species.

Habitats Types at the Water's Edge – In addition to creating a mosaic of riparian forest communities, the natural disturbance regime creates other critical habitats and habitat elements. Channel meander, flooding and aggradation create sloughs and side channels, sand and gravel bars, bare cut banks and shaded banks with vegetation and woody debris extending into the water. All of these features and the vegetation that they support play an integral role in the functioning of the riparian ecosystem.

- **The Open River Channel,** though technically outside of the Wildlife Area, is a key part of the riparian ecosystem. The river channel is the migratory route for the annual runs of multiple species of anadromous fish and it sustains the activities of many avian, reptilian, amphibian and mammalian species. The river channel provides great variation for the species that utilize this habitat. These variations include depth, velocity, cover and riverbed material. Important natural breaks in the consistency of the channel are often formed by vegetative materials that originate in the adjoining river corridor. Large woody debris, often composed of cottonwood or english walnut trees from eroding banks, has been identified as essential components of the habitat that supports fish species including the anadromous species.

- **Shaded Riverine Aquatic Habitat** is an important component of the Sacramento River ecosystem that is created as the river erodes into a bank supporting riparian forests. This is where "the adjacent bank is composed of natural, eroding substrate supporting riparian vegetation that overhangs or protrudes into the water " (U.S. Fish and Wildlife Service, 1992). It is characterized by "variable amounts of woody debris, such as leaves, logs, branches and roots, as well as variable depths, velocities and currents." Shaded riverine habitats with large woody debris provide feeding and cover for aquatic species such as salmon and vital nutrients to help maintain the

overall health of the ecosystem. They also play an important role in regulating water temperature (Triska and Cromack, 1980)

- **Cut Banks** are another important component of the riparian ecosystem along the Sacramento River. These nearly vertical banks, substantially free of plant cover, are found on the outside of meander bends where the river is actively eroding High Terraces. Cut banks support the majority of California's bank swallow colonies. The bank swallow is a migratory species that winters in Central and South America. It nests in the spring, mostly in freshly eroded earthen banks.

- **Sloughs, Side Channels and Oxbow Lakes** are created by channel movements and contribute substantially to the richness of the riparian ecosystem. They provide shelter from the fast currents of the main channel, creating habitat for many species such as beavers and northwestern pond turtles. They provide important rearing areas for fish species, notably chinook salmon, steelhead rainbow trout and Sacramento splittail (Limm and Marchetti, 2003). Sloughs and side channels often have shaded riverine aquatic habitat along their banks. Most heron rookeries are located in tall vegetation surrounding sloughs and oxbow lakes.

❖ Animal Species

Riparian habitats exhibit great diversity of animal species as compared to many other California terrestrial habitats. Most species are permanent residents, but a several species of fish and many avian species are migratory. A more complete listing of the animal species known or expected to exist in the Wildlife Area is included as Appendix E. Overviews of the wildlife and fish populations contained in this section were adapted from materials developed by the USFWS in conjunction with the draft *Comprehensive Conservation Plan for the Sacramento River National Wildlife Refuge* with the input of Department biologists and TNC science staff.

Though substantially fragmented, the existing riparian habitat provides an important migration corridor plus an equally important wintering and breeding habitat for migratory birds. The high value of riparian wetlands for neotropical migrants has been identified by both the Partners in Flight and the Riparian Habitat Joint Venture programs. Riparian vegetation is also home to a variety of mammals, such as the ringtail, which might not occur in the Sacramento Valley if these habitats were absent.

Riverine and lacustrine (related to the edge of a lake) habitats support a diversity of fish, amphibian, reptilian, avian and mammalian species. The aquatic habitats are especially important to anadromous fish species that utilize these habitats for migratory passage and rearing of young. Riparian vegetation that overhangs the river channel, sloughs and side channels in the Shaded Riverine Aquatic habitat is critically important for salmon.

Mammals – Most mammals (with the exception of bats) are year-round residents of the Wildlife Area. Beaver, muskrat, mink and river otter are found in close proximity to the river channel, sloughs, side channels, oxbow lakes and other wetland areas. Several species of bats are common including the red bat and Yuma myotis. Upland species in the riparian forests include rodents such as gray squirrel, deer mouse, ground squirrel, rat, shrew, pocket gopher, California vole and porcupine. Other mammals include the mule deer, black-tailed jackrabbit, desert cottontail, spotted and striped skunk, opossum, raccoon and ringtail. Carnivores include bobcat, the exotic red fox and the native gray fox and coyote.

Birds - Avian species are a major component of the wildlife resource in the riparian habitat. The Wildlife Area supports a wide variety of permanent resident and migratory species.

- **Waterfowl** use the wetland habitats of the Wildlife Area primarily for wintering during the months of August through March. Peak wintering populations occur in December and a small portion remains through the spring and summer months to nest. Common wintering duck species include northern pintail, mallard, wigeon, green-winged teal, gadwall, northern shoveler, wood duck, ring-necked duck, canvasback, redhead and ruddy duck. Common wintering goose species include lesser snow goose, Ross's goose, white-fronted goose and Canada goose. Mallard, cinnamon teal, gadwall, wood duck and lesser numbers of pintail and redhead ducks stay through the spring and summer to nest.

- **Shore birds** use the Wildlife Area in great numbers during their fall and spring migrations with peak populations in April. Common fall and spring migrants include western and least sandpipers, dunlin, dowitcher, black-necked stilt, American avocet, black-bellied and semi-palmated plovers, greater and lesser yellowlegs, long-billed curlew and whimbrel.

- **Wading and diving birds** use the Wildlife Area year-round, using wetland and riparian habitats for foraging, roosting and nesting. Species include great blue heron, green heron, black-crowned night heron, great, snowy and cattle egrets, American bittern, white-faced ibis, Virginia rail, sora, moorhen, American coot, pied-billed and western grebes and the double-crested cormorant. Other waterbirds that use the Wildlife Area during various times of the year include western and eared grebe and American white pelican.

- **Gulls and terns** occupy the Wildlife Area seasonally. Ring-billed and herring gulls are common from the fall into the spring. The black tern occurs during the spring and summer and nests in wetlands and nearby rice fields. Forster's terns occur infrequently, but are often seen in small numbers along the river during spring and fall migrations.

- **Raptors** are a very visible component of the avian population and they are often seen perching along the riparian corridor. Populations are greatest during the winter when the prey base is the greatest. The most abundant wintering species are red-tailed hawk and northern harrier, but bald and golden eagle, white-tailed kite, sharp-skinned hawk, rough-legged hawk, Cooper's hawk, peregrine falcon and short-eared owl occur regularly. Turkey vulture, red-tailed hawk, osprey, bald eagle, white-tailed kite, northern harrier, American kestrel, barn owl and great-horned owl are breeding species. Swainson's hawk is common during the spring and summer when they are nesting in riparian areas.

- **Game birds** inhabit the Wildlife Area year round. Common species include mourning doves, California quail and ring-necked pheasant. Wild turkey populations are also increasing to levels that may soon sustain hunting.

- **Landbirds** inhabit the Wildlife Area in great diversity and abundance. Both resident and migratory species are found. Common year-round wetland residents include marsh wren, Brewer's blackbird and black phoebe. Resident species that can be found in riparian forests include belted kingfisher, Nuttal's woodpecker, acorn woodpecker, northern flicker, California towhee, scrub jay, yellow-billed magpie, American crow, bushtit, Bewick's wren, mockingbird, northern shrike, starling, western meadowlark and house finch. Additional breeding species supported by

these habitats include yellow-billed cuckoo, western wood pewee, ash-throated flycatcher, western kingbird, house wren, American robin, black-headed grosbeaks, titmouse, and tree, violet-green, bank and barn swallows, which are found in riparian and adjoining upland areas during the nesting season. Wintering species include ruby-crowned kinglet, yellow-rumped warbler, lark sparrow, golden-crowned sparrow, white-crowned sparrow and lesser and American goldfinches, which may be found in wetland, riparian or upland areas during the winter. Other common migrants include Anna's hummingbird, downy and hairy woodpeckers, olive-sided flycatcher, horned lark, Wilson's warbler, song sparrow and Lincoln's sparrow.

Reptiles - Common reptile species in riparian areas include the common garter snake, gopher snake, common kingsnake, western fence lizard and alligator lizard. The western rattlesnake also occurs. The northwestern pond turtle and the red-eared slider are found in aquatic and wetland habitats and venture into upland habitats for nesting.

Amphibians - Amphibian species are limited in the Wildlife Area. Common species are the bullfrog, western toad and pacific tree frog.

Fish - Fish are found in the sloughs, side channels and oxbow lakes of the riparian habitat as well as in the adjoining Sacramento River. During periods of high water, species that are normally confined to the river channel occur within the flooded portions of the Wildlife Area. Resident species in these aquatic habitats include bluegill, carp, channel catfish, green sunfish, mosquitofish, Sacramento splittail, smallmouth bass and largemouth bass. Anadromous fish include American shad, chinook salmon, striped bass, green and white sturgeon, and steelhead rainbow trout. Four distinct runs of salmon use the river for access to upstream spawning areas, spawning and the rearing of young.

Invertebrates – Invertebrates are found in the greatest abundance and diversity in the aquatic habitats. They provide an important foodbase for many avian and fish species. Common aquatic invertebrates include waterfleas, snails, clams, dragonflies and damselflies, waterboatmen, backswimmers, beetles, midges, mosquito larva, crayfish and worms. Terrestrial invertebrates such as grasshoppers, beetles, butterflies, including the pipevine swallowtail, moths, midges and ants are an important food base for bats, neotropical migrant birds and waterfowl. The Valley Longhorn Elderberry Beetle nests exclusively within cavities in elderberry plants.

❖ Special Status Species

Adaptation to the riparian habitat has occurred over an extended period of time and each of the species in the Wildlife Area depends on different habitat types and components of the riparian ecosystem. As the habitat area has been reduced and fragmented, some species have been extirpated and others are in danger of being extripated from the riparian corridor of the Sacramento River, the State or becoming extinct. The least Bell's vireo was considered the most numerous songbird along the river in the 1940's, but it was completely absent by the early 1960's. The vireo depended upon the willow scrub riparian community created by river meander. It is thought that the willow scrub habitat declined following flood control projects, increasing the vireo's vulnerability to cowbird parasitism which eventually caused its elimination (Sacramento River Conservation Area Forum, 2002).

The bank swallow is another example of a species that depends entirely upon a specific habitat situation created by the dynamics of the river processes. The bank swallows make their nests in the eroding cut banks that result from the meandering of the river

channel and the river corridor has the greatest concentration of bank swallows in California. Unfortunately, this habitat is the location where landowners and governmental agencies have installed bank protection to prevent property from eroding. The placing of riprap on cut banks eliminates these vital nesting sites and this once common species has disappeared throughout much of its historic range. The Wildlife Area contains multiple sites where remaining cut banks support nesting populations of bank swallows.

Forty (40) Special Status Species are known or expected to occur in the Wildlife Area. Special Status Species are an important focus of this Plan and the management of the Wildlife Area. Under the Ecosystem Approach, management of the riparian habitat communities is directed to maximize benefits for the range of these species as opposed to management at the single-species level.

Table 4 lists the Special Status Species in the Wildlife Area, their State and federal listing status and a description of the habitat that they utilize. Federally-listed species include species that are listed as "Endangered" and "Threatened" pursuant to the federal Endangered Species Act as well as species that are fully protected under federal law. Federal "Species of Concern", as identified by the USFWS, are also noted. State-listed species likewise include species that are listed as "Endangered" and "Threatened" pursuant to the California Endangered Species Act as well as species that are fully protected under State law. Also included are "Species of Special Concern" as determined by the Department. These are species that are not State listed as Endangered or Threatened but, nonetheless, are:

1. Declining at a rate that could result in listing, or
2. Historically occurred in low numbers and known threats to their persistence currently exist.

State Species of Special Concern are divided into three categories. The criteria for these categories differ for each animal group, but generally they indicate the severity of the threat to the species. In Table 4, the numbers 1, 2 or 3 indicate the threat category with 1 being the highest and 3 the lowest. The Table incorporates the Special Status Species listings as of the completion of the Planning Process. It is expected that these listings will change over time as new species are listed and species are delisted as the result of successful conservation efforts.

This Plan addresses the recovery of Special Status Species and the support of other native and game species through an Ecosystem Approach to habitat management. Within this Chapter, threats to the habitats and species are identified and strategies to restore the habitats are established. In Chapter VI, Management Goals, specific Goals and Tasks are proposed to implement these strategies.

❖ Threats to the Habitats and Species

Numerous human activities in the Sacramento River watershed constitute some level of threat to the riparian habitat and the fish and wildlife that inhabit the area. Pollution of the air, the water and the food chain and the allocation of river flows for other uses are broad issues that are beyond the scope of this Plan. There are also direct, local threats to the viability of the riparian ecosystem that should be addressed in the context of this Plan.

Loss of Natural Riverine Processes - Natural processes of the Sacramento River have been greatly modified. The natural processes of erosion, deposition and seasonal

Table 4. Special Status Species Known or with Potential to Occur in the Wildlife Area

Species	Status			Habitat
	CNPS	State	Federal	
Fish				
Chinook salmon, Central Valley Sp.-run *Oncorhynchus tschawytscha*	-	ST	FT	Sacramento River and its tributaries for spawning and rearing
Chinook salmon, Sac. River W-run *Oncorhynchus tschawytscha*	-	SE	FE	Sacramento River and its tributaries for spawning and rearing
Chinook salmon, Central Valley F/late F-run *Oncorhynchus tschawytscha*	-	SC (2)	FC	Sacramento River and its tributaries for spawning and rearing
Central Valley steelhead *Oncorhynchus mykiss*	-	-	FT	Sacramento River and its tributaries for spawning and rearing
Green sturgeon *Ascipenser*	-	SC (1)	FC	Sacramento River for spawning and rearing
Hardhead *Mylopharadon conocephalus*	-	SC (3)	-	Sacramento River and its tributaries for spawning and rearing
River lamprey *Lampreta ayresi*	-	SC (3)	-	Sacramento River and its tributaries for spawning and rearing
Sacramento perch *Archoplites interruptus*	-	SC (2)	-	Sacramento River and its tributaries for spawning and rearing
Sacramento splittail *Pogonichthys macrolepidotus*	-	SC (1)	-	Shallow backwater areas for foraging and rearing
	-			
Wildlife				
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	-	-	FT	Elderberries are the sole host plant for nesting
Giant garter snake *Thamnophis gigas*	-	ST	FT	Backwater areas / mashes with suitable prey, high ground for protection from floods
Northwestern pond turtle *Clemmys marmoratta marmoratta*	-	SC (2)	FC	Backwater areas and oxbow lakes with aquatic vegetation
Least bittern *Ixobrychus exilis*	-	SC (3)	FC	Marshes along ponds with tules, cattails and rushes
Bald eagle *Haliaeetus leucecophalus*	-	SFP	FT	Tall trees for nesting, protected sites with abundant populations of fish
Golden eagle *Aquila chrysaetos*	-	SC (3) SFP	PR	Tall trees and protected sites with plentiful small/medium -sized mammals for prey
Osprey Pabdion haliaetus	-	SC (2)	-	Tall trees for nesting, protected sites with abundant populations of fish
Northern harrier Circus cyaneus	-	SC (2)	-	Grasslands, meadows and marshes providing tall cover
Cooper's Hawk *Accipiter cooperii*	-	SC (2)	-	Nests in riparian forests and forages in open woodlands
American Peregrine Falcon *Falco peregrinus anatum*		SFP		Forages along rivers and wetlands
Merlin *Falco columbarius*	-	SC (1)	-	Forages along open grasslands, savannas and woodlands
Sharp-shinned hawk *Accipiter striatus*	-	SC (3)	-	Dense forest and riparian habitats
Swainson's hawk *Buteo swainsoni*	-	ST	-	Tall trees for nesting and near by open areas for foraging
Short-eared owl *Asio flammeus*	-	SC (2)	-	Freshwater marsh, lowland meadows with dense tules or grass for nesting and roosts

Long-eared owl *Asio otus*	-	SC (2)	-	Dense stands of cottonwoods and willows with adjacent open areas for foraging
American white pelican *Pelecanus erythrhycchos*	-	SC (1)	-	Sloughs and side channels with a prey base of small fish and amphibians
Double-crested cormorant *Phalacrocorax auritus*	-	SC (2)	-	Open water for foraging, nests in riparian forest or protected islands
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	-	SE	FC	Dense riparian forests with a thick understory of willows for nesting and cottonwood overstory for foraging
Willow flycatcher *Empidonax traillii*	-	SE	FC	Riparian areas with abundant willows for breeding
Bank swallow *Riparia riparia*	-	ST	-	Cut banks with sandy or sandy loam soil for nesting
Loggerhead shrike *Lanius ludovicianus*	-	SC (na)	FC	Open habitats with scattered shrubs, trees and other perches
Yellow warbler *Dendroica petechia bewersterii*	-	SC (2)	-	Riparian areas with willows, cottonwoods, sycamores or alders for nesting
Yellow-breasted chat *Icteria virens*	-	SC (2)	-	Riparian areas dominated by willows, alders, Oregon ash, tall weeds blackberry and grape for nesting
Tricolored blackbird *Agelaius tricolor*	-	SC (na)	-	Nests in dense colonies in emergent marsh vegetation, nesting habitat must be large enough to support 50 pairs
Towsend's big-eared bat *Corynorhinus towsendii pallescens*		SC (2)	FC	Forages along edges of riparian habitats, may roost in cavities in trees
Ringtail *Bassariscus astutus*	-	SFP		Riparian forest habitats
Plants				
Columbian watermeal *Wolffia brasiliensis*	CNPS 2	-	-	Marsh habitats
Four-angled spikerush *Eleocharis quadrangulata*	CNPS 2	-	-	Marsh habitats
Fox sedge *Carex vulpinoidea*	CNPS 2	-	-	Marsh and riparian habitats
Rose mallow *Hibiscus lasiocarpus*	CNPS 2	-	-	Wet banks, marshes and riparian habitats
Wright's trichocoronis *Trichocoronis wrightii*	CNPS 2	-	-	Marsh and riparian habitats

Status Key	California Native Plant Society	
	CSP 1	Plants rare, threatened, or endangered in California and elsewhere
	CSP 2	Plants rare, threatened, or endangered in California but more common elsewhere
	State of California	
	SE	State-listed, Endangered
	ST	State-listed, Threatened
	SC	State Species of Special Concern
	SFP	State Fully Protected
	Federal	
	FE	Federally-listed, Endangered
	FT	Federally-listed, Threatened
	FC	Federal Species of Concern
	PR	Protected under Golden Eagle Protection Act

flooding continually changed and enriched the riparian areas, creating and sustaining habitat. Human intervention has seriously interfered with this self-perpetuating system. The regulation of river for water supply, flood control and other purposes has changed the annual flow regime and bank protection has stalled channel meander. As a result, the Sacramento River has lost some capability to maintain existing habitats and create new ones.

The regulation of flows for water supply and flood control that is provided by Shasta Dam has a substantial impact on the riparian habitat. The flood flows are reduced in the winter and spring such that the frequency and duration of inundation are reduced. As a result, the natural distribution of sediment, seeds and other materials that helped to create and maintain habitat is altered. The rate of flow is greatly increased in the summer season and varied in response to water demand, especially those south of the Delta. When in contradiction to the natural regime, this operational control has been found to have negative impacts on the establishment of certain types of riparian vegetation (Roberts et al., 2003).

Bank protection can stall the meander function and with it the creation of habitat. Meander features such as sloughs, side channels and oxbow lakes are not developed, and a comparatively sterile environment can result. The natural variations in channel depth, velocity and vegetative matter are diminished. Areas of shaded riverine aquatic habitat are lost and the contribution of large woody debris to help sustain the downstream fishery is greatly reduced. These substantial impacts on the wildlife and fishery resources affect both the area where bank protection is applied and a substantial downstream reach (U.S. Fish and Wildlife Service, 2000). A portion of the Wildlife Area and a substantial portion of the surrounding banks have been lined with riprap to limit erosion and channel movement.

Habitat Loss and Fragmentation - The substantial reduction and disruption of the riparian habitat has had major negative impacts on the wildlife and fish populations of the Sacramento River riparian corridor. Research indicates that only about 10 % of the combined Valley Oak Woodland and Great Valley Riparian Forest in the river corridor between Colusa and Red Bluff remains (Golet et al., 2003). In addition the majority of the associated wetland basins that are located east and west of the river have been converted to agricultural and urban uses. The net effect is a huge reduction in the overall area of the habitats that once supported healthy and diverse populations of fish and wildlife.

A serious ramification of this habitat loss along the riparian corridor is habitat fragmentation. Habitat fragmentation occurs when large and contiguous tracts of natural vegetation are converted to other uses such that only fragments of the original habitat types remain. This fragmentation affects wildlife in various ways that include direct loss of habitat, increased edge effect and isolation effects. The species most effected are those with large home range requirements, species with narrow or very specific habitat needs and species that lack the ability to disperse and adapt. Habitat fragmentation also disrupts migration corridors along the river and connecting to its tributaries.

Each species requires a specific arrangement of food, water and cover to meet its biological needs. In addition, each species requires a minimum amount of suitable habitat area. For example, the western yellow-billed cuckoo requires dense deciduous forest with dense understory cover near slow-moving water. The species generally selects these habitats for nesting only if they are in contiguous stands of at least 25 acres in area and at least 300 feet in width (Gaines, 1974). Smaller and narrower sites are seldom used. When species minimum home range sizes are

greater than the available fragment sizes, they are frequently eliminated. Therefore, a consequence of habitat fragmentation is a reduction in richness and diversity of species with the greatest impact being observed in small or linear-shaped fragments.

For area-sensitive species like cuckoos, edge effects further reduce the viability of otherwise suitable habitat areas. Where one habitat type borders another, edge effect can be negative for species that require large blocks of contiguous habitat. The fragmentation of habitat tends to increase the amount of the edge relative to the amount of the interior space. The qualitative habitat reduction due to edge effects has been documented for birds in the riparian forest to include increased nest predation, interspecific competition and reduced pairing and nesting success. Edge effects have been documented to extend 150 to 1800 feet into the interior of fragmented forest habitats **(**Paton, 1994).

Isolation effects lessen a species ability to move between fragments of habitat. It is theorized that isolated fragments may support lower densities of species than similar sized areas of contiguous habitat and that the long-term potential for survival is less. Birds and bats generally have excellent dispersal capabilities while small mammals and some species of reptiles and amphibians typically have significantly poorer capability to disperse. The habitat surrounding the Wildlife Area has been substantially reduced in area and greatly fragmented.

Nonnative, Invasive Plant Species - Nonnative, invasive plant species that were not present prior to European settlement have become established along the Sacramento River. Some were imported for a variety of purposes that included erosion control, food crops, animal fodder and garden stock and accidental introduction. In some cases these plants displace or preclude the establishment of native plant communities. They also provide relatively low habitat value for the wildlife species that have adapted to the native species. Some "successful" invasive species feature adaptations such as the production of large amounts of seeds, fast growth, and the ability to reproduce from small pieces of the plant. Adding to this advantage is the frequent lack of natural herbivores, parasites, diseases and a release from the competitive pressure of plants from its native environment.

An example of such a species is giant reed (*Arundo donax*), a large bamboo-like plant. It is able to reroot from small pieces that are distributed by flood events. It is well adapted to alluvial deposits and often proliferates in the same locations that historically support willow scrub communities. It grows extremely fast (3 ½ inches per day under optimal conditions) and manual attempts to remove the plant often result in pieces floating downstream to form new stands. It burns easily and but will resprout vigorously after a fire. Such fires may, over time, eliminate any remaining riparian plant species.

Other invasive species such as tree of heaven (*Ailanthus altissima*) appear to "fit" into the riparian environment but provide poor habitat because they lack low cover value or structure or because the seeds that they produce are of low nutritional value. Some plants, such as edible fig, have the ability to produce chemicals (phytotoxins) that inhibit the germination of competing plant species. Nonnative invasive species that have particularly serious disruptive impacts to the riparian habitat include:

Ailanthus altissima	tree of heaven
Arundo donax	giant reed
Centaurea solstitialis	yellow starthistle
Ficus carica	edible fig
Rubis discolor	Himalayan blackberry

Sorghum halepense	johnson grass
Tamarix chinesis	salt cedar
Lepidium latifolium	perennial pepperweed

Some units of the Wildlife Area, especially on higher elevation locations where flooding is now less frequent, have become dominated by nonnative invasive species such as johnson grass and yellow starthistle. These exotic communities are acting to preclude the establishment of natural riparian vegetation such that, in some cases, the natural succession process of habitat communities appears to have effectively been stalled.

Fire – The potential for wildfires to substantially impact the riparian habitat is a possible, serious threat to the both the habitat and the related fish and wildlife species. Research has suggested that the lack of a natural flooding regime that formerly washed out vegetative materials from the riparian areas can result in increase in fire fuel. This greater fuel load might then support more intense fires, which could impact the composition and structure of habitat communities (Ellis 2001). Given the existing impairment of the natural riverine processes that historically created and renewed riparian habitat, the concern has been raised that future fires could severely damage natural riparian vegetation that could lack the natural means of regeneration. This situation could be worsened if nonnative species invade and proliferate in riparian areas following a fire.

The magnitude of this additional threat is not known. It is known that fire has impacted riparian habitat in the past although some impacts have been considered positive and some plants are adapted to respond positively to fire events. The riparian forest is a relatively moist environment compared to upland habitats. The impacts of fire should, however, be the subject of further monitoring and research and this Plan should be appropriately revised if there is documentation that the threat from wildfire is substantial. Regardless, a fire protection strategy should be maintained for the Wildlife Area for the protection of both the habitat resource and the adjoining property.

❖ Ecosystem Approach to Management

The Department, the SRCAF and the CALFED Program all support an Ecosystem Approach to the restoration and management of riparian habitat along the Sacramento River. This is the concept of achieving species management objectives by sustaining and enhancing the fundamental ecological structures and processes that contribute to the well being of the communities and species that depend on the habitats that are unique to this ecosystem. The basic objective is to restore and rehabilitate, where feasible, the natural processes that create and sustain the important elements of the ecosystem structure. The Ecosystem Approach differs fundamentally from the more traditional approach of species–based management, which seeks to manipulate specific environmental factors thought to limit target species populations at levels below management objectives. An example of species-based management would be the direct removal of predators from an environment to reduce predation levels on a target species. In the context of the Wildlife Area and the entire Sacramento River Conservation Area, the Ecosystem Approach seeks to restore and support natural riverine processes and resolve impediments to restoration through the application of the best available scientific information and Adaptive Management of the habitat.

Strategies to restore the riparian habitats are proposed in order to achieve the Purposes of this Plan, the Goal of the Sacramento River Conservation Area Forum

and the Restoration Priorities of the CALFED Program. It is recognized that the Department will implement these strategies in coordination with the managers of other public and private lands in order to meet these shared objectives. Specific Goals and Tasks to implement these strategies are contained in Chapter VI, Management Goals.

Restoration of Natural Riverine Processes – Restoration of natural riverine processes is the most important component of the Ecosystem Approach. This includes actions that permit the river to meander and create habitat through the natural processes of erosion and deposition. This involves permitting the river to erode the Wildlife Area and not placing artificial constraints in the way of that process. It may involve the removal of bank protection after appropriate analysis and socioeconomic consideration. It may also involve cooperation with flood damage reduction projects such as the proposed Hamilton City project where a new levee, located a distance from the river, would permit the improved passage of floodwaters. Habitat restoration is an important component of the proposed funding plan for the project. Support for flow regime modifications that are supportive of the natural recruitment of riparian vegetation is also important. Restoration of natural riverine processes will require the action of the Department in coordination with other public agencies and private conservation entities as well as other stakeholder groups along the river corridor.

Consistent with the SRCAF Principles, it is recognized that there may be some situations where bank protection may ultimately be required to protect major existing uses and investments such as buildings, pumping plants, bridges, etc.
Such determinations should be made on a site-specific basis, after thorough technical analysis, consideration of all practical alternatives and appropriate mitigation.

Reestablishment of the Habitat Corridor – The SRCAF has established a Goal and a process for the preservation and reestablishment of riparian habitat that has been endorsed by all of the County governments in the SRCA as well as the key State and federal agencies involved in conservation activities. Information, education and consensus building in regard to the value and importance of riparian habitat have been identified as major keys to the preservation of the habitat. Acquisition of habitat in fee title and conservation easement by the Department and other public agencies from willing sellers is included in the program to permit direct management of the habitat resource. Preservation and management of habitat by private landowners is also vital to the success of the effort. The SRCAF was established to serve as a means to coordinate this effort and involve the many persons who are stakeholders in the future of the Sacramento River corridor. This Plan proposes support for and coordination with all these forms and variations of habitat conservation planned for the SRCA.

The area surrounding the Wildlife Area has experienced both substantial habitat loss and habitat fragmentation. To help deal with the effects of habitat loss and fragmentation, the preservation and restoration of habitat should be directed to sites which are hydraulically and geomorphically connected to the river with a priority given to:

1. The assembly of large, contiguous areas, with high interior to edge ratios.
2. The preservation and restoration of sites which fill gaps and expand corridors of protected habitat.
3. The preservation of sites with significant existing habitat value.

This strategy will result in the greatest ecosystem benefit for the resources expended.

Control of Nonnative, Invasive Plant Species – The control of nonnative, invasive plant species is an important element of the maintenance and restoration of riparian habitat. Invasive species can dominate a site and preclude the natural recruitment of riparian vegetation. They can also diminish the habitat value of individual sites. Due to the presence of these species in the other areas of the river corridor and the interconnections that exist through flood flows, the control of invasive, nonnative species will be an ongoing concern.

All Units of the Wildlife Area should be initially evaluated for the presence of invasive, nonnative species and an initial treatment plan should be devised and implemented. Ongoing control will then be required as part of the maintenance of the Wildlife Area in order to preserve the quality of the habitat. Controls may involve mechanical removal, chemical control, burning or other methods. Control or eradication of invasive species should also continue to be a standard part of any future, active horticultural restoration projects.

Active Horticultural Restoration – The replanting of riparian vegetation may be required to restore some portions of the Wildlife Area to native riparian habitat. Within the Wildlife Area 505 acres of riparian habitat have been replanted with native species as listed on Table 5. The preferred method of restoration is to permit natural processes to restore the riparian habitat. In portions of the Wildlife Area, especially in Low Terrace locations that are frequently inundated, natural recruitment of riparian vegetation has occurred. The river has been actively reworking these areas and creating new habitat. However, it has been the experience of the public and private entities that manage habitat along the river that the natural processes have been so modified that natural restoration of habitat does not occur within a reasonable timeframe in some locations. This has particularly been the situation on High Terrace sites where three key factors appear to contribute the lack of adequate natural recruitment. These key factors that affect these natural processes are:

1. Bank protection has limited the meander of the river and the resultant creation of new habitat areas.
2. Changes to the flow and flooding regime have reduced the natural capability to recruit riparian vegetation.
3. Competition from nonnative, invasive vegetation has severely limited the establishment of riparian plants.

Table 5. Previous Active Horticultural Restoration Sites

Unit / Subunit	Year	Acres	Habitat Communities
Pine Creek - West	2003	235	Great Valley Riparian Forest & related communities
Jacinto	2000	38	Great Valley Riparian Forest & related communities
Beehive Bend	2000	58	Great Valley Riparian Forest & related communities
Princeton - North	1994	23	Great Valley Riparian Forest & related communities
- North	2000	27	Great Valley Riparian Forest & related communities
- East	1992	44	Great Valley Riparian Forest & related communities
- South	2001	34	Great Valley Riparian Forest & related communities
Moulton - North	2001	46	Great Valley Riparian Forest & related communities
Total	-	505	-

The previous restoration occurred as part of eight separate projects with the first occurring in 1992 and the most recent in 2002. In each area it was determined that the natural processes alone would not restore the area to riparian habitat of sufficient value in the near term. The planting followed a detailed scientific analysis of the site characteristics and the development of a plan for the planting and initial maintenance of the area. The planting was limited to native species in a design that responded to existing site characteristics that included soils, drainage, inundation frequency and surrounding land uses. Irrigation was generally provided for a three-year establishment period.

As part of the Site Inventory that was prepared for each Unit and Subunit of the Wildlife Area, an initial identification was made of sites that could benefit from active horticultural restoration. Six portions of the Wildlife Area, with a total area of approximately 432 acres, were identified for further evaluation. These were sites where natural processes had not resulted in substantial colonization by native riparian communities over substantial periods of time (from 10 to 25+ years). These sites, are listed on Table 6.

Table 6. Sites for Evaluation of Future Active Horticultural Restoration

Unit / Subunit	Approximate Area (ac.)	Description
Merrill's Landing	130	Former row crop and grassland area, dominated by invasive, nonnative species. No substantial recruitment for 25+ years.
Dicus Slough	80	Former row crop and almond orchard area, dominated by invasive, nonnative species. No substantial recruitment for 10+ years.
Wilson Landing	165	Former row crop and grassland area, dominated by invasive, nonnative species. No substantial recruitment for 25+ years.
Pine Creek – East	42	Abandoned walnut and almond orchard surrounded by riparian forest. No substantial recruitment for 12+ years.
Stegeman	10	Abandoned walnut orchard surrounded by riparian forest. No substantial recruitment for 13+ years.
Colusa - North	5	Abandoned walnut orchard surrounded by riparian forest. No substantial recruitment for 10+ years.
Total	432	-

To further evaluate the appropriateness of horticultural restoration on these sites soils stratigraphy and other physical factors should be studied as well as consideration of the cost effectiveness of the active horticultural restoration of these sites. Horticultural restoration is considered an appropriate method of restoration only in situations where there is strong evidence that the restoration of the site to valuable riparian habitat will not occur through natural processes alone in a reasonable timeframe. Appropriate restoration may include some combination of the following actions: control of invasive, nonnative species, removal of remnant orchard trees and replanting with natural riparian species. It is also possible that further analysis will conclude that active restoration strategies are not required on some sites. As with all

previous, active horticultural restoration projects, the design would incorporate the requirements of the Reclamation Board.

It is also possible that some areas of natural riparian vegetation may require active horticultural restoration in the future if key riverine processes that support the natural regeneration and maintenance of plant communities are not restored. The plants in the riparian habitat have evolved to adapt to the ongoing disturbance regime and to flourish in that environment. If the environment lacks the natural ranges of variability of physical processes, it is not known how the natural riparian vegetation will adapt to that change. If natural riparian vegetation is not sustained by the processes of erosion, deposition and flooding, natural recruitment may not occur in some areas. Such areas could be invaded by nonnative species that could have a substantially lower habitat value, which might not support Special Status Species, other native species and game species.

This scenario involves several unknowns. First, the extent of the restoration of the natural riverine process that will be accomplished in the future is unknown. Process restoration is the key strategy of this Plan, the SRCAF and the CALFED Program, but there are substantial social and economic considerations to be resolved. Second, it is unknown exactly how the riparian vegetation might respond to an altered environment over the long term. Finally, it is not known how the fish and animal species that inhabit the Wildlife Area will respond to any, as yet unknown, change in habitat composition. This potential for altered successional pathways and related impacts to the habitat and the fish and wildlife resources should be the subject of ongoing monitoring and research. This Plan should be appropriately revised if new, credible information indicates that the lack of natural riverine processes will require different, proactive restoration actions in the future.